- Vegetation

Background and Objectives

Vegetation is an important landscape element in any watershed. The distribution of vegetation species may be diverse and highly variable across the watershed, but vegetation communities can be described in more general terms as well. The vegetation module is designed to distinguish the primary plant communities and identify their distribution within the watershed. Because vegetation that grows along streams and other waterways is often quite different from upland vegetation in terms of composition and degree of interaction with aquatic processes, vegetation communities in the three environments (i.e., upland, riparian, and wetland) are characterized separately (Box 1).

In most watersheds, the greatest portion of the total land area consists of uplands. Despite the distance from any waterbodies, upland vegetation exerts important influences upon various watershed processes. For example, upland vegetation may 1) produce leaf litter that affects erosion, 2) modify precipitation inputs through canopy interception, or 3) influence groundwater chemistry through plant decomposition. Although the total area situated along streams and wetlands is normally much smaller, the vegetation in these areas has a more direct effect upon aquatic conditions, providing such functions as shade, streambank reinforcement, and organic litter inputs, among other functions.

Box 1. What and where is riparian vegetation?

Riparian vegetation consists of plants within the zone of direct interaction between terrestrial and aquatic environments (Swanson et al. 1982).

The riparian zone can be defined as the area where 1) vegetation growth is influenced by moisture from the waterbody (e.g., wetland or floodplain area), or 2) vegetation exerts a direct effect upon aquatic conditions (e.g., contributes shade or leaf litter).

Because determining which vegetation exerts a direct effect on aquatic conditions is a complicated task, the analyst will probably need to make some simplifying assumptions. A reasonable starting point to determine the area of riparian influence is to include all vegetation that is influenced by the waterbody (#1 above) plus an additional width equivalent to the height of the tallest plants. If using remote information such as aerial photos, the analyst will probably need to identify a fixed evaluation width along channels.

The primary focus of the Level 1 Vegetation assessment is to identify the primary vegetation types and plot their distribution across the watershed. The assessment methods rely largely upon interpretation of remote information, such as vegetation maps, aerial photos, or satellite images. While the analyst is examining and categorizing vegetation types, land use impacts may become apparent as well.

It is important to realize that vegetation communities are dynamic due to natural plant succession as well as human-caused and natural disturbances. It may take some skill to evaluate past or potential plant community composition based on a remote assessment of existing conditions. The assessment of specific changes in vegetation functions, as well as their causes, will benefit from close coordination with other members of the assessment

team. In addition, the analyst may gain a preliminary sense of which functions the various vegetation types will provide most effectively. However, a determination of the relationship between vegetation function and specific land use impacts will require further consideration via a Level 2 assessment. The following are examples of analyses that would be performed in a Level 2 assessment:

- Assessing vegetation status to finer attributes (e.g., distinguishing tree size or density) or at finer scales of spatial resolution such as the "site" scale (i.e., < 1mi^2 or 1.0 mi of stream length).
- Assessing historical or potential vegetation conditions in detail.
- Assessing the specific land use practices that have created impacts (e.g., refining focus from "logging" to "tractor logging within 200 feet of streams").
- Assessing the effectiveness of various vegetation types or conditions at providing individual functions.
- Assessing changes in aquatic resources that have resulted from vegetation changes.

Vegetation Module Reference Table

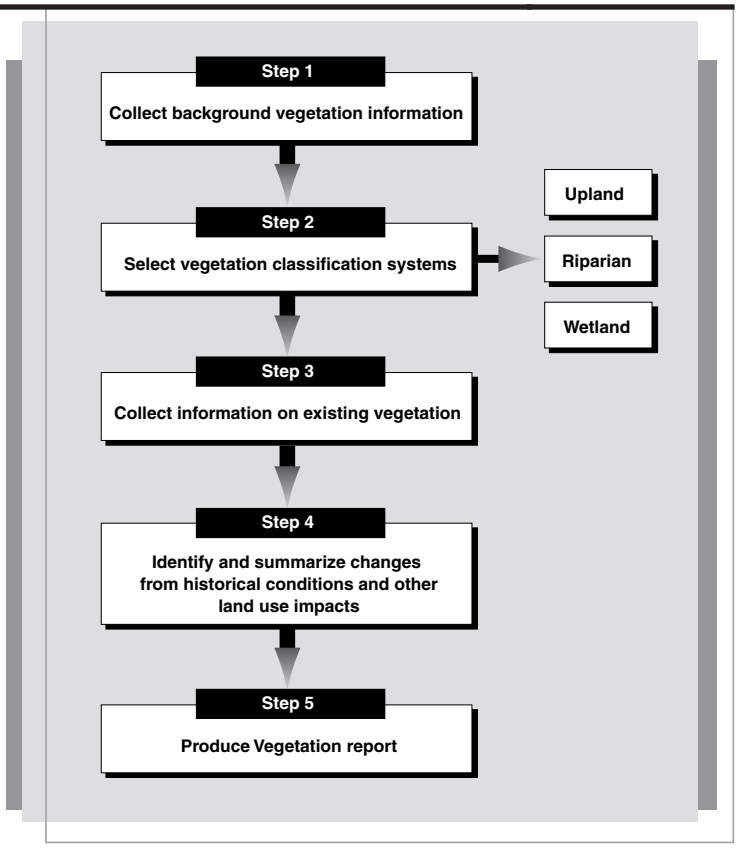
Critical Questions	Information Requirements	Level 1 Methods/Tools	Level 2 Methods/Tools
V1: What are the primary vegetation categories that exist in upland areas?	• Previous vegetation studies • Vegetation maps, GIS data, aerial photos • Anecdotal information	• Prepare upland vegetation map from existing data and aerial photos (reconnaissance level)	• Refine upland vegetation map with further remote or field investigation • Focused assessment of special upland plant species or communities
V2: What are the primary vegetation categories that exist in riparian areas?	• Same as for V1 • Floodplain surveys • Local "sensitive" or "critical areas" inventories	• Prepare riparian/wetland vegetation map from existing data and aerial photos (reconnaissance level)	• Refine riparian/wetland vegetation map with further remote or field investigation • Focused assessment of special riparian plant species or communities
V3: What are the primary vegetation categories that exist in wetland areas?	• Same as for V1 • NWI maps • Soil surveys and hydric soils lists • Recent wetland delineations or assessments • Local sensitive or critical areas inventories	• Prepare riparian/wetland vegetation map from existing data and aerial photos (reconnaissance level)	• Refine riparian/wetland vegetation map with further remote or field investigation • Focused assessment of special wetland plant species or communities
V4: Does existing upland, riparian, or wetland vegetation differ substantially from historical conditions?	• Same as for V1-V3 for present conditions • Land use map • Historical vegetation maps • Old aerial or oblique photos • Old timber or stream survey narratives	• Document location and approximate extent of changes identified from remote or historical sources (reconnaissance level)	• Quantitative assessment of historical change that evaluates the area of vegetation involved and change in functional effectiveness • Reconstruct natural vegetation disturbance history: - flooding - wildfire - windthrow - avalanche - drought
V5: What are important functions of upland vegetation relative to watershed processes?	• Upland vegetation map prepared for V1 • Anecdotal information	• Develop preliminary list of upland vegetation functions	• Numerous methods depending on upland function; coordinate with other analysts

Vegetation Module Reference Table (continued)

Critical Questions	Information Requirements	Level 1 Methods/Tools	Level 2 Methods/Tools
V6: What are important functions of riparian vegetation relative to watershed processes?	• Riparian/wetland vegetation map prepared for V2 and V3 • Anecdotal information • Recent riparian assessments	• Develop preliminary list of riparian vegetation functions	• Multi-function Proper Functioning Condition assessment • Wood recruitment potential ratings approaches • Wood recruitment modeling • Shade assessment
V7: What are important functions of wetland vegetation relative to watershed processes?	• Riparian/wetland vegetation map prepared for V2 and V3 • Anecdotal information • NWI maps • Soil surveys and hydric soils lists • Recent wetland delineations or assessments • Local sensitive or critical areas inventories	• Develop preliminary list of wetland vegetation functions	• Wetland Evaluation Technique • Hydrogeomorphic Classification System
V8: What land use practices have influenced or could influence vegetation conditions and functions?	• Anecdotal information • Aerial photos • Maps/GIS data	• Document location and approximate extent of changes identified from remote or historical sources (reconnaissance level)	• Detailed analysis of individual land use types • Quantitative assessment of vegetation modification (change in vegetation area or functions provided)

Level 1 Assessment

Step Chart



Data Requirements

- Map of watershed with stream network shown. The map should preferably indicate either stream order or any regulatory categorization used locally (e.g., "Water Types" or "Stream Classes"). If GIS maps cannot be generated, USGS topographic maps (1:24,000 scale) will be sufficient.
- Any existing vegetation reports and maps that differentiate basic land covers or define ecological zones.
- Floodplain surveys and maps (FEMA or other source).
- Any wetland maps or recent wetland delineations (e.g., NWI).
- Recent aerial photos or satellite images of sufficient resolution for identifying vegetation types.
- Historical aerial photos or other data describing historical vegetation conditions (e.g., historical land survey notes, fish habitat surveys, or USFS forest distribution maps).
- A list or inventory of threatened, endangered, or sensitive plant species found in the region (federal or state natural resource agencies).
- Soil surveys and hydric soils lists.

Products

- Form V1. Vegetation category summary
- Map V1. Upland vegetation
- Map V2. Riparian/wetland vegetation
- Map V3. Land use practices that affect vegetation
- Vegetation report

Procedure

The primary objectives of the Vegetation assessment are as follows:

- To characterize vegetation types that exist in upland areas of the watershed.
- To characterize vegetation types that exist in riparian and wetland areas of the watershed.
- To identify land uses or land use practices that have caused or contributed to changes in vegetation.
- To identify watershed-related functions provided by vegetation in uplands, riparian areas, and wetlands.

Step 1. Collect background vegetation information

Although the "Data Requirements" section lists items that may be useful, the critical elements are as follows:

- A watershed map that shows the stream network to serve as a base map.
- Existing vegetation information describing current or past vegetation in the watershed (Box 2). This information could consist of maps, photos, site surveys, plant studies, monitoring data, etc. (Box 3).
- Remote data resources, such as aerial photos or satellite images.
- A list of rare or culturally significant plant species present in the watershed (Box 4).

Box 2. A practical note

Although the analyst may be able to locate data resources in libraries or on the internet, a good shortcut may be to contact an individual who has a thorough knowledge of the available documentation on resources in the assessment area. Knowledgeable persons often include local land managers or agency employees with long-term involvement in resource issues. They may be willing to loan information the analyst can review or reproduce.

Community Resources

Box 3. Places to look for vegetation maps

- Tribal resource agencies
- BIA
- BLM
- USFS
- NRCS
- State or local agencies (particularly forestry, wildlife, fisheries, or water quality oriented)
- University or community libraries

Box 4. Examples of culturally significant riparian and wetland species

Brown ash (Penobscot River basin, Penobscot Indian Nation, Maine): Riparian tree species valued for traditional basket making.

Common reed (Cibecue Creek basin, White Mountain Apache, Arizona): A plant used to make arrow shafts and ceremonial objects. Interviews with cultural advisors consistently revealed that common reed used to be more abundant. Field trips with students led to the identification of places where this plant grew. These areas became source areas for transplants used in restoration projects.

Camas (Quinault River watershed, Quinault Nation, Washington): Wet-meadow plant whose tuberous roots were a preferred native food source. Quinaults traditionally introduced fire to maintain forest openings (camas prairies) in order to maintain preferred growing conditions.

Step 2. Select vegetation classification systems

Separate classification systems will be needed for upland, riparian, and wetland areas, although some consistency in approach among the three is desirable. Because there is no single system that will be appropriate for all possible locations, the analyst must ultimately choose or develop a useful system. Consider the following when choosing a vegetation classification system:

- Start by reviewing any classification systems already in use. Use of an existing system will facilitate input from individuals who may use these systems. It may be necessary to either lump or sub-divide existing categories to provide an array of categories that provides a balance between simplicity and detail.
- If no classification systems have been used within the watershed, it may be possible to import a system being used for similar neighboring areas. Classification systems should be based on the species composition where possible rather than on vegetation age or size, which change over time.
- A good system will distinguish vegetation differences that correspond to important functional differences. For instance, distinguishing riparian conifer forest from willow vegetation is important because conifers can provide wood debris to the channel, while shrubs cannot (Box 5).

Box 5. Notes on vegetation classification systems

Countless systems have been developed to characterize vegetation communities, some based on gross differences (forest vs. desert), some distinguishing subtle differences in prevalence among the same handful of species (see example below). The best classification system for use in the Vegetation module is the simplest system that captures important functional differences among vegetation categories. The chosen system should also be mapable at the scale being used for other products. Depending on the size and complexity of the watershed, a manageable system would result in approximately 5-20 distinct vegetation categories.

The example below shows how vegetation can be classified at finer levels of resolution. Using a finer scale system, such as the Plant Associations system on the right, will involve considerably more complication and difficulty in delineating vegetation types accurately without extensive field checking. The hypothetical watershed used to produce this table contains three Major Groups: Alpine, Forest and Range vegetation. If each of these Major Groups can be broken into three subcategories (i.e., Dominant Vegetation Types), and each of these can be broken further into three Plant Associations, that will result in nine Types and 27 Plant Associations. Thus, delineating at the intermediate level is most practical for watershed scale assessments. It is also likely that functional differences between the Plant Association categories are fairly minor.

Example of vegetation classification system

	Overall level of detail		
	General *Major Groups*	**Intermediate** *Dominant Vegetation Types*	**Specific** *Plant Associations*
	1 *Alpine*	**2a** *Spruce/fir*	**2bi** *Lodgepole/huckleberry*
	2 *Forest*	**2b** *Lodgepole pine*	**2bii** *Lodgepole/pine grass*
	3 *Range*	**2c** *Juniper*	**2biii** *Lodgepole/rabbit brush*
Applicability for Vegetation module:	Probably too broad	May be OK	Probably too detailed

- Ideally, each of the categories should be identifiable from remote data, such as aerial photos. If category distinctions are too subtle, they may not be easily distinguishable and could become cumbersome to map and use (Box 6).

Step 3. Collect information on existing vegetation

This step, which consists of collecting and compiling vegetation information, comprises the bulk of new information generated within the Vegetation module.

Box 6. A methodology note: characterization of upland vs. wetland and riparian vegetation

Although the steps for characterizing and mapping vegetation are essentially the same for upland, riparian, and wetland vegetation, it may or may not be best to gather and process data simultaneously. The best approach depends on the information sources available.

If the analyst will be using the same information source(s) to characterize upland, riparian, and wetland vegetation (e.g., aerial photos for all), it may be most efficient to do all concurrently. On the other hand, if the analyst will be using separate sources (e.g., existing vegatation maps for uplands vs. aerial photos for riparian), it may be best to do the steps separately for each vegetation type. There might be intermediate options as well, such as doing some of the steps together. For instance, field verification of upland and riparian vegetation could probably be conducted during the same field visit.

Upland vegetation

a. Make or acquire a base map that will serve as a draft upland vegetation map upon which to collect notes and do preliminary mapping. USGS topographic maps are a good option; most already distinguish forested areas from non-forested and agricultural areas.

b. Consult any existing information on vegetation. Record information on the draft upland vegetation map.

c. Inspect vegetation on aerial photos or other remote data sources. If little existing vegetation information is available, aerial photos may be the primary source. Alternatively, even if vegetation types have been previously mapped, photos may be useful to verify accuracy (especially if existing maps are out of date) or fill in blank areas. In addition, the analyst may decide to sub-divide or lump some vegetation categories that were used.

d. Record observations of land use impacts (Box 7).

e. Visit a sample of sites to validate or refine boundaries. Depending on access and terrain, it might be possible to review sizable areas from a vehicle. Field inspection might reveal vegetation differences that correspond with elevation, aspect,

Box 7. Recognition of vegetation alteration on aerial photos

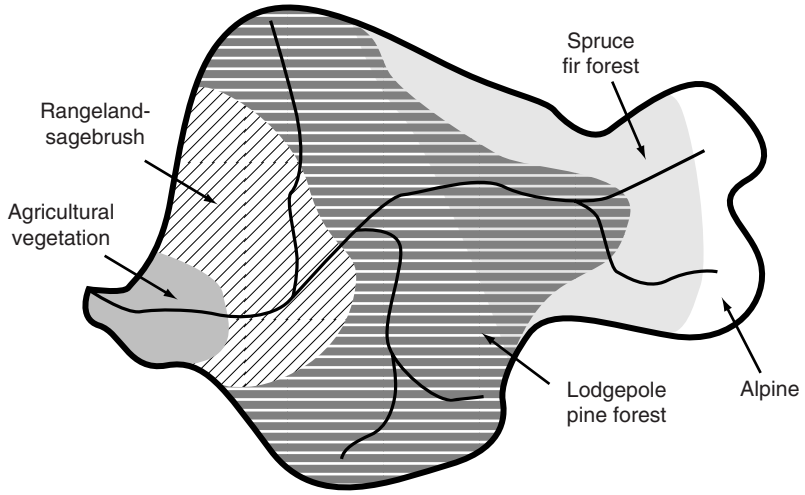
Clearing for agriculture - tilled soil or smooth-appearing crop cover will be evident.
Logging - distinct patches without trees likely indicate clearcut harvest; selective logging will be less obvious, but areas of sparse forest or yarding roads may be apparent.
Grazing - will be hard to see from photos if dispersed; there may be visible trails along fence-lines or bare spots where animals congregate.
Fire - darkened ground inside burned areas; edge of burn will be distinct, but irregularly-shaped; may be able to see plant remnants, such as burned trees.
Mining or quarries - pits will show up as light-colored areas where rock is exposed; hole may be visible when viewed in stereo; underground mines may be identified by piles of tailings, mine buildings, etc.

When confronted with photo interpretation difficulties, it may be possible to find someone with local knowledge or excellent photo skills to consult.

or landform type, and that information could be extrapolated to inaccessible areas using topographic maps or aerial photos.

f. Fill in Form V1 for each vegetation category and create the final upland vegetation map (Map V1; Figure 1).

Figure 1. Sample Map V1. Upland vegetation



Riparian and wetland vegetation

a. Make or acquire a base map that will serve as the draft riparian/wetland vegetation map. This map should show channels and wetlands, as well as roads and section lines if possible, to make it easier to transfer information from maps or aerial photos. The analyst may need to do some additional research to locate wetlands (Boxes 8 and 9).

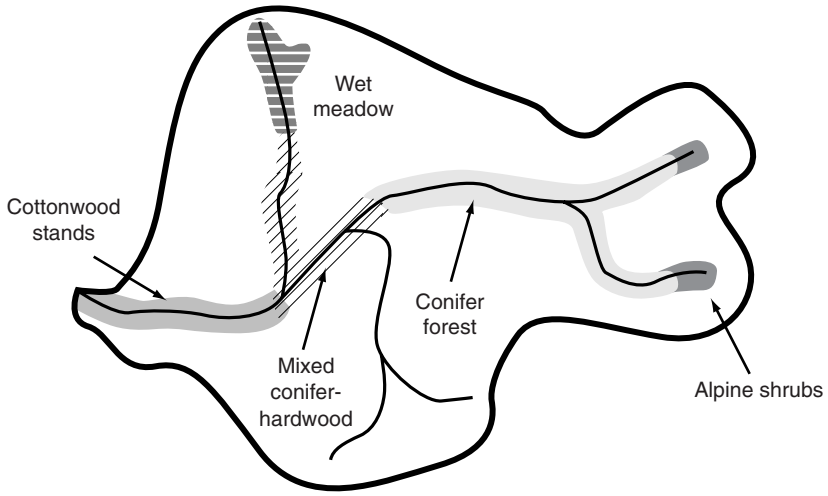
Box 8. Locations of channels and wetlands

USGS topographic maps generally provide good representation of the channel system, although they may not show all of the smaller channels and wetlands, especially in forested areas. Probably the best widely-available source to provide a more complete inventory of wetland locations is the National Wetlands Inventory (NWI). The NWI covers most of the United States and uses the USFWS classification system (Cowardin et al. 1979), described in Box 9. Likely places to find local NWI maps are county planning agencies or the NRCS. There may also be independent wetland studies, such as site-specific reports prepared for individual projects. In some cases, aerial photos (especially large-scale or color) can be used to help map small streams or wetlands.

b. The remaining procedure is the same as for upland areas (i.e., sub-steps b. - f., above), with a few exceptions. For aerial photo evaluation (sub-step c.), the analyst will first need to determine an evaluation width (Box 1). For field verification (sub-step e.),

the analyst will probably find that inspection of riparian and wetland areas will require more on-foot visits, rather than vehicle inspection. Riparian and wetland vegetation information can be combined on one map (Map V2; Figure 2).

Figure 2. Sample Map V2. Riparian/wetland vegetation



Step 4. Identify and summarize changes from historical conditions and other land use impacts

Changes in vegetation conditions can be determined from aerial photos or other documentation. Historical changes can be easily determined if they are obvious and long-term, such as conversion to agriculture or urban use (Box 10). It may be harder to identify gradual changes in vegetation (e.g., from long-term grazing or fire suppression) unless they have already been documented.

Community Resources Historical Conditions ▶

Ongoing land use is easier to identify because it can be verified at any time. For instance, rather than plotting individual clearcuts from logging in the past decade, delineate the entire area managed for logging over a longer period. These changes can be identified from aerial photos, field visits, and local knowledge.

Box 9. Wetland definition and classification

Because wetlands are regulated under federal laws, a system was needed to determine exactly which criteria would distinguish wetlands from uplands. The widely used definition of wetlands is based upon the presence of three indicators: wetland plants, hydric soils, and surface water or soil saturation at some time within the growing season (USACE 1987).

The analyst will not need to make wetland determinations for the Vegetation module but will likely use a system for wetland classification. The most common system for wetland classification is one used by the NWI: the USFWS or Cowardin system (Cowardin et al. 1979). This system indicates the water feature (marine, riverine, etc.) and vegetation type (forest, shrub, etc.) of each wetland. This system is well suited for use with the Vegetation module, especially if NWI inventory data are already available. The second commonly used system is the Hydrogeomorphic Classification System (Smith et al. 1995), which classifies wetlands on the basis of hydrologic and landform setting. The Hydrogeomorphic Classification System is well suited for determining the role of wetlands in watershed processes, but it has the disadvantage of not including any characterization of vegetation.

Box 10. Documenting historical vegetation modification

An example from the Cibecue Creek Watershed, White Mountain Apache Reservation, Arizona

In the 1950s and 1960s, the Cibecue Creek watershed was the subject of an extensive program to convert areas of native pinyon-juniper woodlands, riparian cottonwoods, and other vegetation types to grass cover. The stated goals of the project were to expand grazing resources, provide work for local Apache residents, and "possibly increase water yield from the watershed." Thirty years later, accelerated erosion was more evident than were water yield increases (which did not result), and the net benefits from this program were debatable. Despite the apparent failure of this project to meet its stated goals, it did produce some information resources that may be valuable for watershed assessment, such as pre-treatment vegetation and soils data. Also, the location and extent of areas subjected to treatment were fairly well documented.

This vegetation conversion project differs from most other instances of large-scale vegetation conversion in that it occurred relatively recently and was well documented. Such documentation is extremely valuable for assessing the nature of impacts that have resulted from historical vegetation changes.

Box 11. Common ecosystem functions attributed to vegetation

Upland vegetation

- Effects on erosion (soil cover, root strength, organic matter production)
- Effects on hydrologic processes (evapo-transpiration, snow accumulation and melt)
- Habitat and cover for biota

Riparian vegetation

- Influence on bank stability and channel morphology
- Source of in-channel wood debris (mainly important to physical channel processes)
- Source of litter and fine organic input (food source for biota)
- Habitat for biota
- Moderation of water temperatures from shade (Box 12; also covered in Water Quality module)

Wetland vegetation

- Sediment trapping
- Source of wood debris for habitat
- Nutrient uptake
- Habitat and cover for biota

Assessment of land uses and practices is necessary to determine causes for alteration of riparian areas, removal of vegetation, and consequent effects on streams and community resources. The assessment procedure requires aerial photo interpretation and limited field checking.

a. Identify the land use practices. Most activities should have been identified in the Scoping process, while observations from the aerial photo analysis should provide supporting information on the location and extent of land use practices.

b. Identify resulting impacts. This should include a description of the changes to vegetation species and communities. In many cases, specific practices have changed over time, sometimes for the better (e.g., restrictions on grazing or logging along streams may have been implemented). As possible, such changes should be noted and considered in sub-step d.

c. Make a list of possible impacts to vegetation functions. For Level 1 assessments, functions will be inferred for each general vegetation type (Box 11). Reductions in function will be

Box 12. Assessment of riparian shade effects on water temperature

In some watersheds, shade from riparian vegetation plays a major role in maintaining cool stream temperatures required by cold water species, such as trout and certain amphibians. In other streams (large rivers for example), the influence of riparian shade is minimal and upstream dams or water withdrawals are dominant influences. Because of the variable importance of shade effects upon water temperatures, water temperature issues are assessed in the Water Quality rather than Vegetation module. In watersheds where riparian vegetation has an important influence, it may make sense for the Vegetation analyst to undertake a widespread evaluation of riparian shade. Discussion between the Vegetation and Water Quality analysts will be helpful to determine an effective approach for the two modules.

assumed to correspond to the extent that the original vegetation has been altered; however, this assumption is not always accurate. Therefore, the preliminary identification of impacts to functions can provide hypotheses for further Level 2 assessment.

d. Evaluate trends in recovery or restoration (Box 13). Evaluate the long-term outlook for recovery of impacted areas if the practices continue or are discontinued.

e. Present results of the land use assessment. Land use practices that affect vegetation should be identified on Map V3 (Figure 3). More than one map may be necessary if there are many land use impacts that overlap for a given location.

f. Summarize results. Create a table or a narrative to present at Synthesis that describes land use practices, impacts on functions, and trends in recovery or restoration.

Box 13. Recovery potential from land use impacts

Natural recovery likely

- Logging
- Grazing
- Flood damage
- Fire

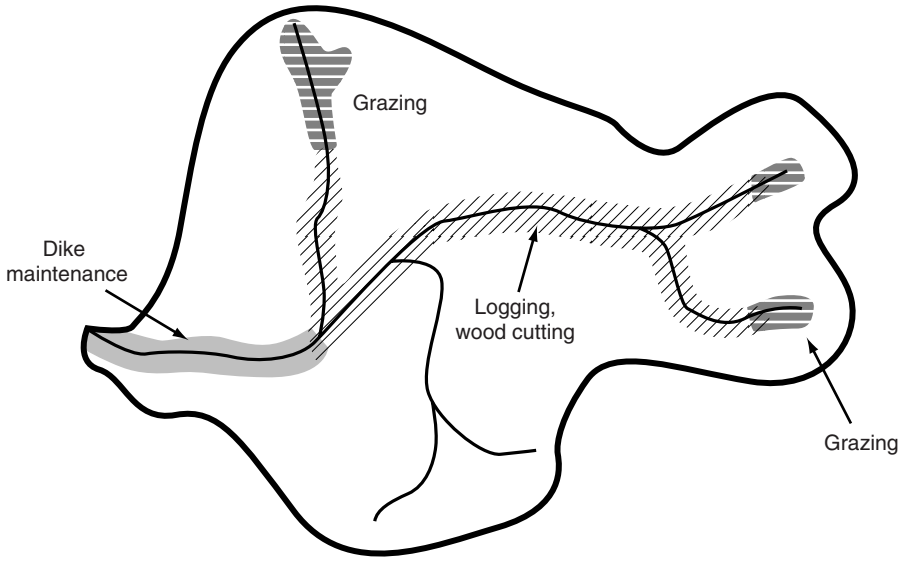
Restoration possible

- Conversion to agriculture
- Vegetation conversion

Restoration difficult

- Conversion to urban
- Floodplain or wetland modification (e.g., diking, filling, etc.)

Figure 3. Sample Map V3. Land use practices that affect vegetation



Step 5. Produce Vegetation report

In addition to the three maps and the vegetation summary forms, the Vegetation report is an important end-product of this assessment. The report need not be elaborate or lengthy but should document the following components:

- **Assessment methodology:**
  - Vegetation classification systems chosen and why.
  - Riparian assessment width used and justification.
  - Primary information sources: vegetation studies, maps, aerial photos, field investigation, etc.

- **Results of the assessment:**
  - Distribution of upland, wetland, and riparian vegetation categories.
  - The extent and severity of historical vegetation modification and ongoing land use practices.
  - Watershed functions provided by each vegetation category.

- **Topics for Level 2 assessment; examples include the following:**
  - Trends in vegetation that result in changes in vegetation functions..
  - Functions requiring further assessment (e.g., nutrient cycling, wildlife habitat).
  - Issues involving rare or culturally significant plant species.

Level 2 Assessment

The information generated from a Level 1 assessment, such as the key vegetation types in uplands, wetlands, and riparian areas across the watershed, can be useful for guiding a Level 2 assessment (Table 1). A Level 1 assessment may not address certain priority watershed issues or processes related to vegetation except in a broad or hypothetical way. Synthesis brings the Vegetation assessment into a broader context of watershed issues and provides an excellent forum to identify priority issues relating vegetation functions to aquatic resources and watershed processes (Box 14).

Box 14. Examples of vegetation-related priority issues and hypotheses suitable for Level 2 assessment

Although many potential priority issues are likely to arise during Synthesis, the analyst will need to select a manageable number for assessment. Once priority issues have been chosen, it will be valuable to develop hypotheses (i.e., testable statements that are narrower and specifically focused on the role of vegetation). Hypotheses that involve issues covered by other modules will require collaboration with other analysts.

Issue: Streambank erosion has increased.
Hypothesis: Grazing has reduced the abundance and vigor of bank-reinforcing vegetation.
Assessment Method: Land use or riparian functions.
Collaboration: Assessing bank erosion should involve the Channel analyst.

Issue: Waterfowl habitat has been reduced.
Hypotheses: Wetland filling for agricultural use in the last 100 years has resulted in reduced waterfowl habitat.
Assessment Method: Historical change or wetland functions.
Collaboration: Community Resources analyst.

Issue: Grass species have been gradually replaced by juniper and sagebrush.
Hypothesis: Vegetation composition has changed substantially as a result of fire suppression.
Assessment Method: Historical change.
Collaboration: Community Resources analyst may be able to help assess the importance of reduced forage.

Issue: Input of wood debris that creates trout habitat in streams has been reduced.
Hypothesis: In riparian areas that have been logged, there is less wood debris entering the stream or available for recruitment.
Assessment Method: Evaluation of specific land use practices or riparian functions.
Collaboration: Aquatic Life analyst should be consulted to guide assessment of fish habitat.

The Level 2 assessment employs more focused assessment techniques to address more specific issues (Table 1). Because the major task of the Level 1 assessment is vegetation characterization, the first three critical questions will have been largely covered. It is more likely that priority issues for Level 2 will fall within the topics covered by Critical Questions 4-8: changes from historical conditions, vegetation functions, and effects of individual land uses.

Table 1. Summary of Level 1 products and possible avenues for Level 2 assessment

Topic	Products from Level 1 assessment	Considerations for Level 2 assessment
Types and locations of primary vegetation categories	Maps of vegetation categories	More effort may be required to improve the resolution of vegetation category locations using additional field effort or photo interpretation.
Vegetation changes from historical conditions	Major changes noted on vegetation maps	Detailed analysis of historical changes may be useful, especially if an understanding of target conditions is necessary and undisturbed reference sites are not available.
Functions of upland, riparian, and wetland vegetation	Preliminary lists of functions for each vegetation type	Analysis of individual functions and their importance to ecological processes can be valuable.
Effects of land use practices on vegetation	Information on land use practices and changes in vegetation	Further analysis could be valuable to evaluate land use effects and to identify changes in practices necessary to improve vegetation conditions or functions.

Because this module is designed for use across a very broad array of natural landscapes and vegetation types, there is no single method that will be suitable for all Level 2 issues and settings. Rather, this discussion provides an outline of the general steps and several broad approaches to vegetation assessment. Many methods have been developed for use in various parts of the United States. The analyst will need to choose from existing methods or develop a method suitable for the vegetation issues at hand. For this reason, the Level 2 assessment relies heavily on the skills and judgement of the analyst to identify methods suitable for the local environment and adapt one of these for the local landscape and issues identified.

There are several general approaches that may be useful in evaluating the priority issues of a Level 2 Vegetation assessment. The following section is designed to introduce these approaches, to help the analyst determine which are best suited to the identified issues, and to provide limited guidance on how to pursue them most effectively. The organization of the general approaches follows the issues listed in Table 2.

Table 2. Methods available for Level 2 assessment

Issues	Critical questions	Information requirements	Level 2 methods/tools
Types and locations of primary vegetation categories	V1-V3	Various remote and direct sources: aerial photos, maps, GIS, field surveys, etc.	• Further investigation with aerial photos or field visits • Detailed assessment of special habitat types
Vegetation changes from historical conditions	V4	Any documentation of historical vegetation conditions.	• Analysis of historical documentation (see Sedell and Luchessa 1982, Platts et al. 1987)
Functions provided by upland, riparian, or wetland vegetation	V5-V7	Information on upland, riparian, and wetland functions. Information requirements differ among methods.	**Upland functions:** • Various methods depending on upland function; coordinate with other analysts **Riparian functions:** • Wood recruitment potential ratings (e.g., WFPB 1997, Watershed Professionals Network 1999) and recruitment modeling (e.g., Van Sickle and Gregory 1990) • Multi-function Proper Functioning Condition assessment (Prichard et al. 1998) • Shade assessment; collaborate with Water Quality analyst **Wetland functions:** • Wetland Evaluation Technique (Adamus 1991) Hydrogeomorphic Approach (Smith et al. 1995)
Effects of individual land use practices on vegetation	V8	Information on specific land use practices: information from field investigation, aerial photos, GIS, agencies, etc.	• Various regionally-applicable methods

Evaluation of Historical Vegetation Changes

Method summary

Identify long-term changes in upland, riparian, or wetland vegetation using documentation of historical conditions, such as old aerial photos, land survey notes, or narratives.

Primary benefits

A characterization of historical conditions can be extremely helpful in understanding long-term trends in resource conditions (e.g., "Is vegetation removal responsible for the widening of streams observed over the last 50 years?"), as well as providing a detailed target for restoration. The historical picture is particularly useful for environments that have been substantially modified and thus lack relatively non-degraded locations to serve as reference sites. Historical vegetation conditions can also be used to create targets for the desired levels of functions or to evaluate the degree of change in present vegetation. In addition, this approach is the only one likely to provide insight (though indirect) into the vegetation-influencing role of natural disturbance agents (e.g., wildfire, beaver activity) that have been diminished or are no longer active.

Limitations

The extent and reliability of documentation available to support such an assessment is highly variable from place to place. Documentation of conditions prior to 1900 is likely to be quite limited, which reduces the applicability of this approach in areas with a long history of land modification. Another challenge is extrapolating information from photos or descriptions, which are typically site-specific, to the landscape scale. One final caution is that because historical descriptions are largely qualitative, their use is subject to considerable interpretation. Levels of resolution and confidence may be inadequate to satisfy all community members in contentious situations.

Resources needed

- Old aerial photos with coverage that may go back to the 1930s or 1940s.
- Old landscape photos.
- Old maps or land survey notes (land survey notes often include descriptions of vegetation).

- Written or oral narratives of tribal elders or long-time residents.
- Field surveys (especially useful in areas where remnants of past vegetation, such as tree stumps, persist).
- Any other historical documentation.

Other considerations

Practically speaking, a historical vegetation study should be undertaken only if 1) the types of information generated will be valuable, and 2) a preliminary inventory indicates that sufficient documentation is available to produce a satisfactory portrayal.

Although historical investigations are increasingly common, there is little documented guidance available (see Table 2 for two references). To a large extent, the quality of the product depends on the diligence of the analyst.

Evaluation of Upland, Riparian, or Wetland Vegetation Functions

Method summary

Evaluate the effectiveness of present vegetation at providing one or more key ecosystem functions, such as streambank reinforcement or wildlife habitat. Ideally this can be done using an existing methodology; however, in some situations, the analyst may choose to modify an existing method to fit local conditions.

Primary benefits

Functions assessment has numerous advantages, particularly when an existing evaluation tool is available. Application of a widely accepted method takes advantage of the familiarity and confidence associated with the method. Methods that focus on one or two key functions are likely to be more objective than are holistic methods (Box 15). A function-based approach is best suited to an area in which a relatively unaltered vegetation community exists to serve as a standard for comparison.

Limitations

The utility of an assessment that focuses on one or two individual functions depends on choosing appropriate functions, such that other key functions are not overlooked. If

Box 15. Two general approaches to functions assessment: individual function and holistic, multi-function

Individual function assessments assess one or more functions directly by evaluating components of the vegetation community that correspond with the levels of function provided. Ideally, such methods are supported by a strong scientific understanding based upon studies that have defined quantitative linkages between vegetation conditions and levels of function. The assessment of one or several well-understood functions at the exclusion of others is often justified by the presumption that vegetation conditions that provide assessed functions will also provide acceptable levels of other functions not considered. Examples of this approach include watershed analysis methods used in both Oregon (Watershed Professionals Network 1999) and Washington (WFPB 1997), both of which evaluate only shade and wood debris input for riparian vegetation.

Holistic, multi-function assessments assess function levels on the basis of the similarity of existing vegetation to a pre-determined "reference condition" assumed to provide acceptable levels of all desired functions. Some methods of this type simply assume that if the vegetation contains all the right components, the functions will follow, while others include a qualitative evaluation of various individual functions, as in the Functional Checklist used to evaluate Proper Functioning Condition (Prichard et al. 1998).

an existing assessment method is available, the relevance of the results depend on 1) the effectiveness of the method, and 2) the suitability of the method to the site where it will be used. Functions assessment may be poorly suited to the evaluation of lingering impacts from conditions or practices that have been discontinued.

Resources needed

- Documentation of any existing assessment methods available.
- Consultation with individuals experienced in use of these methods.
- Maps, aerial photos, or other resources required by the method.

Other considerations

Identification of key functions is an important step. Box 11 in the "Level 1" section lists several vegetation functions to consider, although there may be others important locally that are not included.

Finding and choosing a suitable method is also critical, and it is worthwhile to check with local experts first. If a suitable method cannot be found for a priority issue, check

the library or internet to find methods used in other locations that could be modified. Another option is to use a general, multi-function method, such as the Proper Functioning Condition approach (Prichard et al. 1998).

Evaluation of Specific Land Use Practices

Method summary

In watersheds where several land use types are dominant, it may be useful to assess the impacts of specific land uses individually. The assessment will rely on the same techniques used for the historical change and function assessment approaches discussed previously. The unique aspect of the land use specific approach is that it includes an in-depth assessment of the specific land use practices involved to support detailed recommendations.

Primary benefits

This approach will be highly effective in watersheds or sub-basins where there is a single, obvious, dominant land use practice occurring. This approach should be considered for watersheds where information to support revising particular land use practices is desired.

Limitations

The focus on a single land use may increase the potential to miss important impacts of secondary land uses or processes. Also, it may be hard to evaluate recent changes in practices unless some time has passed.

Resources needed

- Aerial photos.
- Maps and GIS data of logged areas, grazing allotments, etc.
- Land use maps.
- Consultation with and information from land managers or agencies involved in the particular land use of interest:
  - All land use types - tribal or county planning/zoning agencies.
  - Forestry - forestry agencies or companies.
  - Agriculture/grazing - NRCS.

Community Resources

Other considerations

It is important to assess not just the location of practices but the extent of physical effects, such as soil disturbance, vegetation damage, and changes in the prevalence of plant species. It is also important to evaluate time trends, such as changes in practices over time or recovery trends.

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Form V1. Vegetation category summary

Vegetation category:

Location:

- ☐ Upland
- ☐ Riparian
- ☐ Wetland

Primary species:

Unique or culturally valuable plant species present:

Land use impacts:

Functions:

Field sites visited: